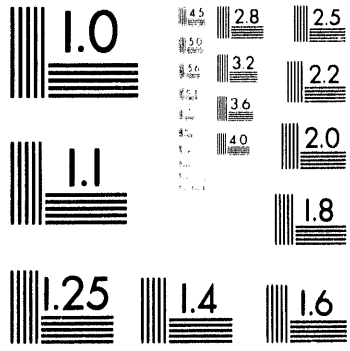
1.0
1.1
1.25
1.4
1.6
1.8
2.0
2.2
2.5
2.8
3.2
3.6
4.0
4.5
5.0
5.6

1 of 1

Interim Technical Report

DOE/ER/12794-1

NCSU PULSTAR Reactor Instrumentation Upgrade

UNIVERSITY REACTOR
INSTRUMENTATION PROGRAM
US D.O.E. Reference Number DE-FG07-90ER12974

P.B. Perez

S.J. Bilyj

North Carolina State University
Department of Nuclear Engineering
Nuclear Reactor Program
Raleigh, North Carolina 27695-7909

12 August 1993

DISCLAIMER

ABSTRACT

The Nuclear Reactor Program at North Carolina State University initiated an upgrade program at the NCSU PULSTAR Reactor in 1990. Twenty-year-old instrumentation is currently undergoing replacement with solid-state and current technology equipment. The financial assistance from the United States Department of Energy has been the primary source of support. This interim report provides the status of the first two phases of the upgrade program.

TABLE OF CONTENTS

1.0 INTRODUCTION

The Nuclear Reactor Program (NRP) is administratively a part of the Department of Nuclear Engineering where there is close collaboration between the faculty and the NRP staff. Nuclear Engineering courses and associated laboratories use the PULSTAR Reactor as a teaching tool. Both undergraduate and graduate students engage in a variety of projects involving the PULSTAR Reactor as part of the general requirements to obtain their academic degrees. The published Mission Statement for the NCSU PULSTAR Reactor is as follows:

> *The Nuclear Reactor Program (NRP) was instituted to provide specialized nuclear facilities to the North Carolina academic and industrial communities for the purpose of teaching, research and service. In addition, these nuclear facilities are made available to provide services to the state and federal agencies to support governmental activities.*

The one megawatt PULSTAR Reactor continues to meet its mission of teaching, research and service by having provided over 18,000 megawatt•hours of full power operation since initial criticality in September 1972.

The PULSTAR Reactor has operated quite successfully over the past twenty-years with very little operating time lost to equipment failure. However, the probability of equipment problems increase as the equipment ages. The PULSTAR reactor facility began a multi-phase facility upgrade program in 1990. The facility upgrade program was designed to allow for the continuation of the excellent operations and facility availability during it's first twenty years. The upgrade program is multi-phased and prioritizes the systems based on importance to safe operation and facility availability. The upgrades will also enhance the facility's role in teaching, research, training, and services.

The equipment purchased with the DOE and NCSU matching funds will greatly increase the PULSTAR Reactor reliability and availability.

2.0 DISCUSSION

When it was learned that grant monies would become available through the DOE for equipment upgrades, the NRP staff met to discuss the various options based on need and safety. The equipment installed in the first and second phase of this upgrade was the result of that meeting. The first phase of the upgrade program involved the implementation of a data collection system to continually monitor the status of virtually every system, measuring channel, process controller, and radiation level associated with the PULSTAR reactor facility. The second phase of the upgrade program provided a new fixed-site radiation monitoring system with an uninterruptible power supply to prevent data loss during a power failure.

2.1 Upgrade Phase 1 - Data Acquisition System

Continuous monitoring of virtually every process variable at the PULSTAR reactor facility gives the opportunity to recognize trends of possible equipment degradation. The early detection of potential equipment failures allows our preventative maintenance program to correct any problems while minimizing repair costs and facility shutdown time. In addition to monitoring trends, access to the various signals are now available. In the past, signals could not be accessed in real time because there were no isolation devices installed.

The Data Acquisition System for the PULSTAR Reactor is an IBM compatible 80386DX 33 Mhz computer using the Keithley Metrabyte Series 500 data acquisition system and appropriate analog and digital isolation devices. The data acquisition system is located in the PULSTAR Control Room behind the control console. The system is available to the NRP staff for reactor engineering projects, and the faculty and students for undergraduate and graduate studies.

The computer along with the data acquisition system produce different viewing screens to display the status of nearly every parameter that is associated with the

PULSTAR Reactor. The screens are the Menu, Primary System, Reactor Core, Ventilation System, Digital Inputs, Waste Tank System, and the Area Radiation Monitoring System. The Menu screen lists the different screens available for viewing. One needs to only press the first letter of the screen desired to display that screen. The Digital Inputs screen gives the status of all of the individual parameters that are monitored in tabular format. All the remaining screens pictorially show the system and its measured parameter with a digital value or "on/off" status. Also available are calculated values for processes that are time or reactor power dependent such as xenon concentration in the fuel or the differential temperature across the reactor core.

2.2 Upgrade Phase 2 - Radiation Monitoring System

The original radiation area monitoring system, while it had served quite well, had required an increasing amount of maintenance. In addition, the instrument read-outs were an analog gauge displaying a logarithmic value on a linear scale. This made it very difficult to accurately read values and introduced a potential for error in reading the variables. The new equipment is solid-state with digital read-outs which are very simple to read even from a distance. The new radiation area monitoring system is backed-up by an Uninterruptible Power Supply (UPS) which dramatically reduces the number of alarms associated with power line faults.

Radiation levels within the Reactor Building and the building ventilation exhaust are monitored in a single equipment rack along with a trending recorder. Radiation levels are monitored at the following locations: Control Room, Reactor Pool, West Wall, Primary Demineralizer, Stack Gas, Stack Particulate, Filter GM, Auxiliary GM, and the three liquid effluent tanks. The equipment rack was repositioned to the left and at right angles to the reactor operator when seated at the console. This affords a clear view of the radiation monitoring channels. The new equipment is the original manufacture's recommended replacement for the equipment which was installed in 1971. The new uninterruptible power supply (UPS) for the Radiation Monitoring Rack is located

immediately to the right of the Radiation Monitoring Rack. Data from the Radiation Monitoring Rack is sent to the data acquisition system that was explained in Section 2.1 above.

3.0 CONCLUSION

The equipment upgrades described in this interim report are independently functional and are available to provide data for reactor operations as well as Nuclear Engineering laboratories. The Data Acquisition System is not currently integrated into reactor safety related systems pending a final review and approval of the 10 CFR 50.59 safety evaluation.

DATE

FILMED

12/29/93

END